

DISCUSSION OF THE AMENDMENT

Due to the length of the specification herein, Applicants will cite to the paragraph number of the published patent application (PG Pub) of the present application, i.e., US 2007/0142528, when discussing the application description, both in this section and in the Remarks section, *infra*, rather than to page and line of the specification as filed.

New Claims 11-20 have been added. Claims 11-16 are supported by original Claims 3, 6, and 7-10, respectively. Claims 17 and 18 are supported in the specification at paragraph [0015]. Claims 19 and 20 are supported by Spherical silica No. i in Table 4 of Example 2 in the specification at paragraph [0060].

No new matter is believed to have been added by the above amendment. Claims 1-20 are now pending in the application.

REMARKS

Applicants thank the Examiner for the courtesy extended to Applicants' attorney during the interview held February 10, 2009, in the above-identified application. During the interview, Applicants' attorney explained the presently-claimed invention and why it is patentable over the applied prior art. The discussion is summarized and expanded upon below.

The rejection of Claims 1, 3, 4 and 6-10 under 35 U.S.C. § 103(a) as unpatentable over JP 2002/308919 (Nakano et al) in view of JP 2001-139733 (Yamaguchi et al), is respectfully traversed.

An embodiment of the present invention, as recited in Claim 1, is a curable resin composition comprising a (meth)acrylate monomer, an organic peroxide, a decomposition accelerator for the organic peroxide, and an inorganic filler, wherein the inorganic filler has a particle size distribution such that it has peak diameters at least in the respective regions of from 3 to 10  $\mu\text{m}$  and from 30 to 70  $\mu\text{m}$ , and the mode diameter is from 30 to 70  $\mu\text{m}$  and the median diameter is from 5 to 40  $\mu\text{m}$ .

As disclosed in the specification, with regard to known acrylic resins in which flexibility has been imparted, if an inorganic filler to impart thermal conductivity is incorporated in a large amount, the viscosity tends to increase, and when an electronic component is sealed or bonded, workability tends to be poor and it cannot sufficiently infiltrate into the component, or the sealed or bonded resin itself may contain bubbles, and no sufficient heat properties can be secured, citing, *inter alia*, Nakano et al, at paragraphs [0007] and [0009]. Thus, while Nakano et al may disclose a resin composition comprising the presently-recited components, Nakano et al neither discloses nor suggests the presently-recited particle size distribution of their filler.

Acknowledging this deficiency, the Examiner relies on Yamaguchi et al. Yamaguchi et al is drawn to a heat conduction sheet for dissipating heat from heating elements such as electronic parts, wherein the heat conduction sheet comprises a rubber and a thermal conduction filler, wherein the filler comprises particles having a mean particle diameter of 50-100  $\mu\text{m}$  and particles having a mean particle diameter of 10  $\mu\text{m}$  or less, at a ratio of 1:1-3:1, respectively. See paragraphs [0001]-[0004]. By combining these particles of different particle size, Yamaguchi et al is able to obtain a higher filling rate and therefore, higher thermal conductivity. Preferably, the particles having a mean particle diameter of 10  $\mu\text{m}$  or less are particles having a mean particle diameter of 5-10  $\mu\text{m}$  [0018]. The only material disclosed for the thermal conductive filler is silicon carbide.

The Examiner holds that it would have been obvious to employ the particle size profile disclosed in Yamaguchi et al for the filler in Nakano et al to attain a high filling rate.

In reply, without the present disclosure as a guide, one of ordinary skill in the art would not have combined Nakano et al and Yamaguchi et al. As Applicants' attorney pointed out during the above-referenced interview, Nakano et al is concerned with forming an adhesive agent, while Yamaguchi et al is concerned with heat dissipation from heating elements. Moreover, even if one of ordinary skill in the art would have combined Nakano et al and Yamaguchi et al, Yamaguchi et al does not appreciate the significance of the presently-recited maximum particle diameter of 70  $\mu\text{m}$ . As explained by Applicants' attorney during the interview, and as shown in Table 1 at paragraph [0051] of the specification, Spherical alumina No. V contains particles having a peak diameter of 5.1  $\mu\text{m}$  and a peak diameter of 76.1  $\mu\text{m}$ , and are thus within the terms of Yamaguchi et al. However, as shown in Table 3 at paragraph [0054], the viscosity for Sample No. 7 of Comparative Example 1 is 39,000 mPa·s, while the viscosity for samples according to the present invention, as shown in Table 2 at paragraph [0053], is never more than 13,000 mPa·s.

New Claim 19 is separately patentable, since the maximum of 39.8  $\mu\text{m}$  is totally outside the 50-100  $\mu\text{m}$  range of Yamaguchi et al.

The above-discussed examples in the specification are prophetic yet Applicants submit that the data is reproducible. The following explanation details the examples in reference to Tables 1 through 8.

Re: Data in Table 1

Spherical alumina No. in Table 1 of the present application	Referred to the following Examples of JP-A-2003-146648
I	Example 3
II	Example 2
III	Example 5
IV	Example 1
V	Comparative Example 5 (example where the peak diameter exists in a range larger than 70 $\mu\text{m}$ )
VI	Comparative Example 3 (example where the peak diameter exists in the range of from 10 to 30 $\mu\text{m}$ )
VII	Comparative Example 10 (example where no peak diameter exists in the range of from 3 to 10 $\mu\text{m}$ )
VIII	Comparative Example 4 (example where no peak diameter exists in the range of from 30 to 70 $\mu\text{m}$ )
IX	Comparative Example 8 (example where no mode diameter exists in the range of from 5 to 40 $\mu\text{m}$ )

Re: Data in Table 2

In Example 1, each different alumina was added to a (meth)acrylic resin type liquid A. In Sample Nos. 1 to 3, the added amount of Spherical alumina No. I was varied. In Sample Nos. 4 to 6, Spherical alumina Nos. II to IV were added, respectively, in the same manner as in Sample No. 1. The data was obtained by calculation taking into consideration

(1) the examples in that when using inorganic powder having the substantially same particle size distribution as the ones indicated in the examples of JP-A-2003-146648, the melt viscosity of an epoxy type resin is lowered, and (2) the fact that a suitable low viscosity can be obtained by employing alumina having such three peak diameters.

Re: Data in Table 3

In all of Comparative Example 1 (Sample Nos. 7 to 11), the alumina employed all fall outside the scope of the claims of the present invention, and the viscosity is increased because of the following reasons, and operability is inferior to the present invention in view of the flowability.

Sample No. 7 is a case where the mode diameter is beyond 70  $\mu\text{m}$ , by which closest packing is not made and the viscosity increases.

Sample No. 8 is a case where a peak diameter exists in the range of from 10 to 30  $\mu\text{m}$  and there are few gaps between big-size fillers, by which closest packing is not made and the viscosity increases.

Sample No. 9 is a case where no peak diameter exists in the range of from 3 to 10  $\mu\text{m}$  and there are no intermediate-size fillers, by which closest packing is not made and the viscosity increases.

Sample No. 10 is a case where no peak diameter exists in the range of from 30 to 70  $\mu\text{m}$  and there are no big-size fillers, by which closest packing is not made and the viscosity increases.

Sample No. 11 is a case where a median diameter exists in the range of less than 5  $\mu\text{m}$  and fine powder is contained in a relatively large amount, by which closest packing is not made and the viscosity increases.

Re: Data in Tables 4, 5 and 6

As the inorganic fillers, Spherical silica Nos. i to v were used. Spherical silica Nos. i, ii, iii, iv and v correspond to Spherical alumina Nos. I, III, VI, VII and IX, respectively.

The data of Example 2 (Sample Nos. 12 to 15) and Comparative Example 2 (Sample Nos. 16 to 18) were obtained by calculation in the substantially same manner as in Example 1 and Comparative Example 1.

Re: Data in Table 7

The data show the importance of linseed oil (corresponds to “drying oil” as recited in original Claim 5). The result of Sample No. 19 was estimated from the empirical knowledge that when no drying oil is contained, fillers are closely packed and the surface-cured condition is insufficient, by which the resin lacks strength and fillers are partially deposited. And, the result of Sample No. 22 was estimated from the empirical knowledge that when a large amount of drying oil is added, the molecular weight is lowered and partially-uncured state is seen.

Re: Data in Table 8

Regarding Example 4 and Comparative Example 4, the results were obtained on the basis of actual data. The results of Example 4 were prepared from the findings that even if fillers are closely packed, so far as the composition is flexible like the ones of the present invention, stress relaxation is seen in a heat shock test and durability is secured.

The results of Comparative Example 4 were prepared on the basis of the findings that in a case of a hard adhesive, stress relaxation cannot be seen in a heat shock test and peeling is seen.

**Submitted herewith** is a copy of JP-A-2003-146648 and an English machine translation of the examples in paragraphs [0039] to [0047], including Tables 1 and 2, thereof.

In addition, the newly-submitted Oshima Declaration provides data for Spherical alumina Nos. X and XI.

As Oshima declares, spherical alumina No. X has a mode diameter between 70 and 100  $\mu\text{m}$ ; since Spherical alumina No. X has a low tensile lap-shear strength, it does not exhibit the effects of the present invention; and spherical alumina No. XI has the peak diameter within the range less than 10  $\mu\text{m}$ ; since Spherical alumina No. XI has a low tensile lap-shear strength, it does not exhibit the effects of the present invention.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 2 and 5 under 35 U.S.C. § 103(a) as unpatentable over Nakano et al in view of Yamaguchi et al, and further in view of US 2003/0032707 (Hemmings et al), is respectfully traversed.

Claim 2 is drawn to a curable resin composition comprising a (meth)acrylate monomer, an organic peroxide, a decomposition accelerator for the organic peroxide and an inorganic filler, wherein the inorganic filler has a particle size distribution such that it has peak diameters at least in the respective regions of from 0.2 to 1.5  $\mu\text{m}$ , from 3 to 10  $\mu\text{m}$  and from 30 to 70  $\mu\text{m}$ , and the mode diameter is from 30 to 70  $\mu\text{m}$  and the median diameter is from 5 to 40  $\mu\text{m}$ .

Recognizing that neither Nakano et al nor Yamaguchi et al discloses fillers having a trimodal particle size distribution, the Examiner relies on Hemmings et al. Hemmings et al discloses a fly ash filler or filler blend having a particle size distribution with at least three modes that can be combined with a polymer at higher filler loadings to produce a filled polymer for polymer composites that, in many cases, can produce improved mechanical properties for the polymer composites over polymer composites using conventional fillers

(Abstract). The three modes are a median particle diameter of from 0.3 to 1.0  $\mu\text{m}$ , a second mode having a median particle diameter from 10 to 25  $\mu\text{m}$ , and a third mode having a median particle diameter of from 40 to 80  $\mu\text{m}$  [0007]. The particle size distribution preferably includes 11-17% of particles by volume in the first mode, 56-74% of the particles by volume in the second mode, and 12-31% of the particles by volume in the third mode [0007]. The Examiner holds that it would have been obvious to include fillers with trimodal particle size distribution in the adhesive compositions of Nakano et al.<sup>1</sup>

In reply, even if it were generally obvious to employ a trimodal particle size distribution, Hemmings et al does not disclose or suggest the presently-recited distribution, as noted by Applicants' attorney during the interview. Claim 2 requires particles having, *inter alia*, a peak diameter in the range of from 3 to 10  $\mu\text{m}$ , not disclosed by Hemmings et al. In addition, since the second mode having a median particle diameter from 10 to 25  $\mu\text{m}$  is preferably present in an amount of at least 56% by volume, the mode would apparently be somewhere between 10-25  $\mu\text{m}$ , and outside the presently-recited range of from 30 to 70  $\mu\text{m}$ . In addition, the above-discussed comparative data would appear to be relevant herein as well.

New Claim 20 is separately patentable, since the maximum of 39.8  $\mu\text{m}$  is totally outside the 40-80  $\mu\text{m}$  range of Hemmings et al.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

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<sup>1</sup> As Applicants' attorney noted during the interview, the examiner does not appear to be relying on Yamaguchi et al in this rejection.

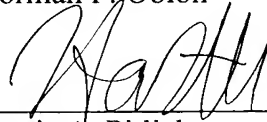


Application No. 10/583,449  
Reply to Office Action of January 7, 2009

All of the presently-pending claims in this application are now believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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A handwritten signature in black ink, appearing to read 'H. Pitlick', is written over a horizontal line.

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